

# COURSE MANUAL

## Course information

**Title** : Concept Formation and Development in Science.

**Code:** PSC 505

**Credits:** 3

**Entry requirements:** The student should have read psychological basis of science/mathematics education at the undergraduate level.

## Instructor(s) information

**Name:** C. Anthony-Krueger, D. K. Taale, and B. Sokpe

**Position:** Lecturers of the Course.

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## Introduction:

*This course is aimed at building on the students' fundamental knowledge about concept formation and its development in science among learners. It will provide theoretical and practical perspectives on cognitive issues related to the learning of science. The students would be expected to carry out investigations on children's learning in the course of study.*

## Subject content

- Psychological basis for effective science teaching.
- Concepts and Concept formation in science.
- Teachers' conceptions of learning.
- **Misconceptions** and strategies for addressing them.
- **Concept maps and their generation**
- Application of learning theories in science and mathematics teaching

## Connection with other courses

- Foundations of science
- Thesis
- Teacher education and supervision
- Curriculum studies

### Learning objectives

By the end of the course, the students should be able to:

- explain what science and mathematics concepts are and how they are formed
- adopt appropriate strategies to help pupils form concepts correctly
- apply the learning theories to classroom practice.
- identify theories operating in observed classroom practices
- discuss relevant aspects that determine teachers' understanding of learning and how they can apply the aspects in their teaching.
- develop their overview of obstacles and opportunities regarding effective teaching and learning of science
- compare their personal views with those expressed in the relevant literature
- help their students use concept maps in learning science
- discuss alternative conceptions with examples and classroom-based data, and provide their own ideas about how alternate conceptions may be addressed in teaching

### Literature and materials

**Compulsory** study texts:

**Supplementary reading (s):**

Trowbridge, L. W., Bybee, R. W. & Powell, J. C. (2004). *Teaching Secondary School Science: Strategies for Developing Scientific Literacy* (8<sup>th</sup> ed). Upper Saddle River, NJ: Pearson Merrill Prentice Hall

### Learning activities

- **Brainstorming** on what concepts and concept hierarchies are. **Discussion** of processes involved in formation of science and mathematics concepts.
- **Discussion** of learner-centered psychological principles: Metacognitive and cognitive factors; affective factors, developmental factors, personal and social factors; individual differences and their implications for science and mathematics teaching.
- **Brainstorming** on what alternative conceptions are and visit to basic and secondary schools to find out learners' conceptions on some science and mathematics concepts. **Discussion** of strategies for addressing the alternative conceptions,
- **Literature search**
- **Practicum** cum peer **critique**
- **Classroom observations**
- **Lecture** interspersed with **illustrations**
- **Brainstorming** on what concept maps are and their generation.
- **Out-of-class and in-class assignments**

### Course schedule:

Unit 1: **Concepts and Concept formation in science.** **Weeks 1-2**  
*Reading assignment:* 1.Trowbridge *et al.* (2004), pp. 210-214 (*from: Using Textbooks Effectively through The Learning cycle*)

*Home work:* Internet search and present a three-page report on topic.  
Individual class presentation and peer critique of report.

**Unit 2: Psychological basis for effective science teaching.**

**Weeks 3-5**

*Reading assignment:* 1. Trowbridge *et al.* (2004), Chp.18, pp. 256-260. Take a careful note of the 12 principles.

*Home work:* 1. Study carefully Activities 18-1 to 18-6 (pp.263-272) and comment on them.  
2. What input do you think you can make to improve on them?  
3. Do you think they are suitable to be used in the Ghanaian setting?  
4. If yes, why? If no, why?

**Unit 3: Teachers' conceptions of learning.**

**Weeks 6-7**

*Home work:* 1. Internet search on what is meant by "Teachers' conceptions of learning?".  
2. Prepare a report for presentation in class. Cite at least *three* examples.  
3. Peer critique.

**Unit 4: Alternative conceptions and strategies for addressing them.**

**Weeks 8-9**

*Home work:* 1. Internet search on topic.  
2. Select a topic suitable to teach in SHS, identify two misconceptions and advance three strategies to address them.  
3. individual presentation and peer critique in class.

**Unit 5: Application of learning theories in science**

**Weeks 10-11**

*Reading assignment:* 1. Trowbridge *et al.* (2004), Chp.19, pp. 274-284.  
2. What is the import of the guest editorial on "Science for Exceptional Students", pp.279-280?

**Unit 6: Constructivist views of learning**

**Weeks 12-14**

*Reading assignment:* Woolfolk, A. (2007) *Educational Psychology*, 10<sup>th</sup> Edition  
Chp.9, pp.343-362.

*Home work:* 1. Each student is prepare a presentation on **one** constructivist lesson and present in class.  
2. Show the merits and demerits of such a lesson which differs from that of traditional teaching method.  
3. Peer critique and contribution(s).

*Note:* 1. Spend at least **one hour** on all reading assignments and home work.  
2. Individual presentations will last a maximum of **20 minutes**.

**Practical sessions / Field work rules of conduct:**

Students should comport themselves when they go on school visits

**Safety:**

**Required materials:**

**Assignments / Portfolio assignments:**

1. Term paper: Explore the teaching and learning theories and their implications to effective science and mathematics education in Ghana.
2. Construct a concept map you would use to teach any topic of your choice in science/mathematics. Explain the basis of your mapping.
3. How would you remove **an identified** science/mathematics misconception among senior/junior high school students?

**Mode of assessment:**

- |                                 |     |
|---------------------------------|-----|
| 1. Presentations                | 10% |
| 2. Written assignments          | 10% |
| 3. Term paper                   | 20% |
| 4. End-of-semester examination. | 60% |

**Grading policies:**

UEW: 60% – 69% Grade C, 70% - 79% Grade B, 80% and above Grade A  
UCC: 60% - 64% Grade C, 65% - 69% Grade C+, 70% - 74% Grade B,  
75% - 79% Grade B+, 80% and above Grade A.

**Assessment rules:**

Assignments and term paper should be handed in **on time**.

**Course policies****Attendance and participation:**

- Students should be punctual at lectures.
- If a student is absent from lectures for more than three weeks, he/she should repeat the course.
- A student who will absent himself/herself from lectures should inform the lecturer in advance.
- Students should be active participants during lectures.

**Code of conduct:**

1. All students should show mutual respect to one another.
2. All dissenting views should be accommodated.
3. All mobile phones should be switched off during lectures.

**Cheating / Plagiarism:**

1. Cheating of any kind is unacceptable.
2. Acknowledge all in-text references.
3. **Reproducing other people's work(s)** is NOT acceptable.
4. **Plagiarism will be severely penalized.**